**AS Unit 1: Basic Biochemistry and Cell Organisation**

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**Topic 1.5 Medical and Industrial Applications of Enzymes – Page 1**

l. Introduction to Enzymes

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|  |  | Completed |
| 1. | Read the notes on the medical and industrial applications of enzymes. |  |
| 2. | Read the following:   * Rowlands p51-54 * Toole p604-606 * Notes on Immobilised Enzymes and Biosensors |  |
| 3. |  |  |

**Medical and Industrial Applications of Enzymes**

Enzymes were first used on a large scale by the textile industry. Thread used for weaving used to be protected by coating it with starch paste – useful as it made the thread slippery and therefore weaving easier. After weaving the starch had to be removed and this used to be done with various chemicals such as acids but they often discoloured the cloth. In the early twentieth century the industry starting using enzyme extracts from an animal’s pancreas. At around the same time the leather industry started to use proteases to remove animal hair from the skins. By 1945 large scale production of enzymes was commonplace.

**Industrial Uses of Enzymes Today**

The ability of enzymes to catalyse specific chemical reactions at body temperature makes them commercially useful tools. Some examples of enzyme use are given below:

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| **Enzyme** | **Reaction** | **Source of Enzyme** | **Application** |
| Glucose isomerase | Converts glucose to sucrose | Fungi | Production of high fructose syrups used in the food industry |
| Proteases | Digest protein | Bacteria | Washing powder |
| Urokinase | Breaks down blood clots | Human urine | Removes blood clots in heart disease patients |
| Glucose oxidase | Oxidises glucose | Fungi | Used to test for blood glucose in for people with diabetes |
| Lysozyme | Breaks 1-4 glycosidic bonds | Hen egg white | Disrupts bacterial cell walls |
| Endonucleases | Breaks DNA into fragments | Bacteria | Used in genetic manipulation techniques eg gene transfer, DNA fingerprinting |

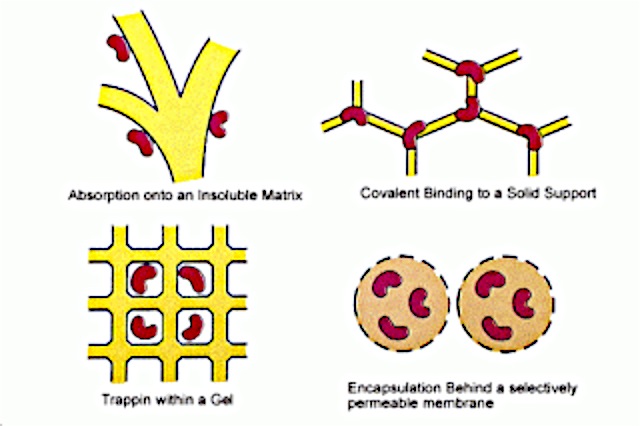
Enzymes used in industry can either be intracellular or extracellular in origin. Extracellular enzymes are easier to isolate, as the organisms producing it can be grown and they will secrete it into a growth medium. Intracellular enzymes are more tricky to obtain as the organisms have to be grown and then the cells need to be broken open to extract the enzymes.

**Immobilised Enzymes**

In an industrial process controlled by an enzyme, the enzyme is usually the most expensive component. Enzymes like most catalysts are not used up in the reaction and therefore they can theoretically be reused.

One disadvantage of simply adding an enzyme to the substrate in solution is that it might then be difficult to separate the enzyme from the product/s. This enzyme many not be easily re-used which would be expensive.

An alternative is to use immobilised enzymes. Immobilised enzymes are bound to a surface so that they are not allowed to dissolve and usually they cannot move. There are several ways of holding and immobilising the enzymes. They are usually bound to an inert support or matrix.



Enzyme immobilization also has the additional benefit of often making the enzyme able to tolerate a wider range of conditions i.e. tolerate a wider pH range or still be stable in structure at temperatures above their optimum. This later fact means that often more than one enzyme can be immobilised onto the same matrix. Enzyme immobilization is important in **biosensors**.

**Biosensors**

Biosensors are instruments that can detect a **specific** molecule or metabolite in a mixture of molecules or body fluids. They can detect molecules at even very low concentrations and give quantitative readings whilst at the same time not contaminating the product because the enzymes are immobilised.

Their specificity is due to the presence of an enzyme. To use enzymes as biosensors they need to be:

* Capable of immobilisation
* Able to withstand changes in pH or temperature
* Specific to the molecule being detected

A simple biosensor involves the immobilization of the enzyme glucose oxidase which is specific for the substrate glucose.

